

Method and device for expanding a metal element

The present invention relates to a method of expanding an elongated and at least regionally planar metal element that has two respective marginal regions that are oppositely disposed and that extend in the longitudinal direction and a central region that is arranged therebetween and that is provided with cuts, wherein the marginal regions of the metal element are moved apart transversely to the longitudinal direction and in parallel with the planar extent of the metal element such that connection portions of the central region formed by the cuts and connecting the marginal regions to one another are folded.

Planar metal elements such as are described in DE 102 59 307 A1 should in particular be expanded using the method in accordance with the invention and using the apparatus in accordance with the invention.

Elongated and at least regionally planar metal elements are used, for example, for manufacturing section elements for the construction industry, in particular upright sections or plaster sections. A widening of the metal element with an unchanging material amount results due to the folding over or folding of the connection portions. Wider metal elements can thus be manufactured by the folding with a reduced material consumption and a reduced weight. A special advantage of the folding process comprises no complex and/or expensive stamping being required for the production of the corresponding cut-outs and in particular no material waste being incurred.

The cutting patterns required for the folding process can be of the most varied type. A plurality of such cutting patterns are described and shown in said DE 102 59 307 A1. For the better understanding of the present application, the disclosure content of DE 102 59 307 A1, in particular with respect to the specifically described and shown cutting patterns, is explicitly included in the content of the present application.

The metal elements in the sense of the present invention are made planar at least in the region of the cutting patterns. In other regions, for example also in the region of the longitudinal sides of the metal elements, the metal elements can also deviate from the planar shape. Thickened regions, steps or bent over regions can in particular be formed at the longitudinal sides. The metal elements can thus e.g. already be preshaped as U-shaped sections or C-shaped sections. The metal elements can furthermore be produced from roll material that is bent in different manners during the manufacture. The term "planar extent of the metal element" is accordingly meant to be the plane of the local extent at the point at which the pulling apart and folding take place. It must additionally be pointed out that parts of the central portion are generally also moved on the moving apart of the marginal regions.

The pulling apart of the marginal regions preferably takes place automatically in a continuous process such as is described in DE 10 2006 010 795 A1. The marginal regions are here gripped by suitable clamping holding apparatus and are pulled apart in opposite directions. Although this method has proved itself in practice, there is a desire for a reduction in the force to be applied for the pulling apart and for more exactly defined folding edges. A particular challenge here comprises the fact that section elements of the initially named kind represent a mass-produced article that is produced at a very high speed, for example 100 to 150 m/min, and that is subject to high cost pressure.

It is an object of the invention to make possible a simpler and more reliable expansion of elongated, at least regionally planar metal elements.

The invention provides that the marginal regions are displaced with respect to one another transversely to the planar extent of the metal element after the generation of the cuts in the central region in a first method step before the moving apart and are moved apart in the displaced state in a subsequent second method step. In other words, the marginal regions and, optionally, also parts of the central region are moved at least locally in two planes displaced in parallel with one another. The connection portions to be folded that are each directly or indirectly connected to both marginal regions are drawn upward here, that is after the displacement they extend obliquely from one of the two parallel planes to the other. This is advantageous to the extent that a favorable lever effect results on the subsequent moving apart of the marginal regions so that the force required for folding is reduced. In addition, the kink points or fold points are already formed exactly at the points intended for them in the displacement process so that inexact kinks or defective kinks are reliably avoided. Due to the advantages achieved by the transverse displacement prior to the folding, it is possible to expand thicker and stiffer metal parts than was previously possible in an economic manner.

A pressing tool or rolling tool whose pressing surface has a step defining the displacement can be pressed onto the metal element to displace the marginal regions. The step can be formed as a unilateral flank between two substantially smooth portions of the pressing surface that at least locally define two planes displaced in parallel with one another. The use of a corresponding pressing tool or rolling tool enables a particularly simple and fast carrying out of the displacement process.

The step is preferably in the region of the central portion on the pressing of the pressing tool or rolling tool onto the metal element so that the marginal regions are accordingly pressed into the two planes displaced in parallel with one another.

An embodiment of the invention provides that the metal element is led through two rotatable rollers whose jacket surfaces have respective peripheral steps having oppositely aligned flanks. It is possible in this manner to carry out the displacement of the marginal regions in a continuous flow.

The rollers can be rotated in opposite directions on the leading through of the metal elements and can in particular be driven in opposite directions.

The marginal regions are preferably displaced with respect to one another by a shape corrected displacement that corresponds to at least three times, and at most 7 times, the thickness of the metal element. Such a displacement has been found to be particularly favorable in practice.

In accordance with a special embodiment of the invention, an embossed pattern is embossed in the central portion before or during the displacement of the marginal regions. Such an embossed pattern effects a stiffening of the expanded metal elements and accordingly an increase in stability in the produced section element. The embossed pattern can in particular comprise reinforcement beads that define recesses. The cuts of the central regions are preferably fully arranged in the recesses of the embossed pattern.

The metal element is preferably moved in the longitudinal direction during the displacement of the marginal regions and/or during the moving apart of the marginal regions so that the carrying out of the corresponding method steps takes place in a continuous flow.

The invention also relates to an apparatus for expanding an elongated and at least regionally planar metal element that has two respective marginal regions that are oppositely disposed and that extend in the longitudinal direction and a central region that is arranged therebetween and that is provided with cuts, in particular to an apparatus for carrying out a method such as described above, having a stretching unit that is configured to hold the marginal regions of the metal element and to move them apart transversely to the longitudinal direction and in parallel with the planar extent of the metal element so that connection portions of the central region connecting the marginal regions to one another are folded.

In accordance with the invention, the apparatus comprises a shape correction unit that is connected upstream of the stretching unit and that is configured to displace the marginal regions with respect to one another transversely to the planar extent. As described above, a favorable lever effect for the following step of pulling the marginal regions apart results from the transverse displacement of the marginal regions by means of the shape correction unit. In addition, the shape correction unit provides an avoidance of inexact kinks or defective kinks.

The shape correction unit can comprise a pressing tool or rolling tool whose pressing surface has a step defining the displacement. This allows a particularly simple construction.

The pressing surface can have at least substantially smooth outer portions that are arranged at both sides of the step, that are associated with the marginal regions of the metal element, and that extend, at least viewed locally, in two planes displaced with respect to one another. The step here forms one or more flanks extending between the planes.

The pressing tool or rolling tool preferably has at least one rotatable roller on whose jacket surface the step is peripherally formed. Such a shape correction unit can process roll material in a flow.

A special embodiment provides that the pressing tool or rolling tool comprises two rotatable rollers between which the metal element can be led, with the jacket surfaces of the rollers having respective peripheral steps having oppositely aligned flanks. The marginal regions and, optionally, parts of the central region are thus respectively clamped between the rollers and in so doing are fixed in a reliable manner in the oppositely displaced planes.

An embossed pattern that preferably extends beyond the step can be formed on the pressing surface. As described above, an embossed pattern has a stiffening effect. The embossed pattern can in particular comprise reinforcement beads that define recesses. The cuts of the central regions are preferably fully arranged in the recesses of the embossed pattern.

The apparatus can comprise a feed unit through which the metal element is movable in the longitudinal direction during the displacement of the marginal regions and/or during the moving apart of the marginal regions. The feed unit can in particular comprise a drive roller or an arrangement of a plurality of drive rollers.

The metal element can comprise galvanized steel, aluminum, or copper depending on the application.

The metal element can furthermore have a thickness of more than 0,5 mm, preferably of more than 0.6 mm. Such thick metal elements can at best be expanded with great difficulty using current methods and apparatus. Due to the reduction in force and the increase in reliability made possible by the

displacement, thicker and stiffer metal elements can also be processed using an apparatus in accordance with the invention.

The stretching unit can have at least two clamping portions for a holding clamping of the marginal regions and an apparatus for the automatic moving apart of the clamping portions. This makes possible a simple and fast performance of the expansion process. The clamping portions can be designed such as is described in DE 10 2006 010 795 A1.

In accordance with a further embodiment of the invention, the apparatus comprises a pressing unit or rolling unit connected downstream of the stretching unit for flat pressing or flat rolling the expanded metal element. The fold points or kink points generated on the folding can be equalized in this manner.

An apparatus in accordance with the invention can comprise an embossing unit connected upstream of the shape correction unit to emboss an embossed pattern in the central portion.

Alternatively, the shape correction unit can have a combined embossing/displacement roller or roll by means of which both the marginal regions can be displaced transversely to the planar extent of the metal element and an embossed pattern can be embossed in the central portion. The displacement of the marginal regions and the generation of the embossed pattern can therefore be carried out in combination at a single work station. A separate embossing unit is then not required.

Further advantageous embodiments of the invention are set forth in the dependent claims, in the description and in the enclosed drawings.

The invention will be described in more detail in the following with reference to an embodiment and to the drawings.

- Fig. 1 shows a part of a planar metal element with a cutting pattern;
- Figs. 2 to 4 show three different states in the expansion of a metal element with the cutting pattern of Fig. 1;
- Figs. 5 to 8 show a state of a metal element after the displacement of two marginal regions of the metal element transversely to its planar extent and before the expansion of the metal element;
- Fig 9 is a perspective view of a shape correction unit of an apparatus in accordance with the invention for expanding a metal element;
- Fig. 10 is a side view of the shape correction unit in accordance with Fig. 9;
- Fig. 11 shows a section along the line A-A in Fig. 10;
- Fig. 12 is an enlarged representation of the detail B in Fig. 11;
- Fig. 13 is an enlarged representation of the detail C in Fig. 10; and
- Fig. 14 is a plan view of a pressing roll of the shape correction unit in accordance with Fig. 9 including a metal element acted on by the pressing roll.

Fig. 1 shows a detail of a planar metal element 11 that has two oppositely disposed marginal regions 13 that extend along a longitudinal axis L and a central region 17 arranged therebetween and provided with cuts 15 engaging into one another. The marginal regions 13 are free of cuts, which is preferred, but not absolutely necessary. The detail shown in Fig. 1 is considerably shortened with respect to the actual length of the metal element 11. In actual fact, the metal element 11 forms a long metal strip which can have a length, for example, of several 100 m.

The metal element 11 is already described in DE 102 59 307 A1 to which reference is explicitly made.

The cuts 15 are arranged such that the marginal regions 13 of the metal element 11 can be pulled apart at right angles to the longitudinal axis L, as is indicated by arrows in Fig. 1. On the pulling apart of the marginal regions 13, connection portions 19 formed by the cuts 15 are folded in the form of narrow webs along kink lines 21 so that a resulting metal element 11 having an enlarged width is generated. A corresponding folding procedure is shown in detail in Figs. 2 to 4.

Correspondingly expanded metal elements can be used, for example, for the manufacture of sections such as are used e.g. as edge protection or as upright sections for dry walls (Fig. 7), e.g. in the form of U-sections and C-sections.

To be able to expand the metal elements 11 known per se at a high speed, as shown in Figs. 2 to 4, an apparatus can, for example, be used such as is described in DE 10 2006 010 795 A1.

In a method in accordance with the invention of widening the metal element 11 shown in Fig. 1, the marginal regions 13 are not pulled apart at right angles to the longitudinal axis L, starting from the base state shown in Fig. 1, but are rather

displaced with respect to one another beforehand in a preceding method step at right angles to the planar extent of the metal element 11. The displaced state is shown in Figs. 5 to 8, with Fig. 5 being a side view transversely to the longitudinal axis L, Fig. 6 being a side view in the direction of the longitudinal axis L, Fig. 7 being a perspective view, and Fig. 8 being an enlarged representation of the region A in Fig. 7. It can be recognized that the two marginal regions 13 and parts of the central region 17 adjoining them extend in parallel planes 25, 26 that are spaced apart from one another, while the connection portions 19 are aligned obliquely to these planes 25, 26. An embossed pattern 27, whose generation will be described in even more detail in the following, is located in the central region 17.

The shape of the cuts 15 of the metal element 11 shown in Figs. 5 to 8 differs slightly from the shape of the cuts 15 shown in Figs. 1 to 4, which is, however, of no significance with respect to the displacement process.

Starting from the intermediate state shown in Figs. 5 to 8, the marginal regions 13 are pulled apart in opposite directions, with the connection portions 19 being folded. Since the kink lines 21 are already formed in the intermediate state and since the connection portions 19 are slanted, the pulling apart can be carried out simply and with reduced pulling force. In addition no defective formation of kink lines 21 can occur. A method in accordance with the invention can therefore also be carried out for metal elements 11 having a thickness of more than 0.6 mm and for hard metal sorts.

With a conventional method for expanding a metal element 11, a displacement of the marginal regions 13 transversely to the planar extent of the metal element 11 likewise takes place since the connection portions 11 that fold over press the adjacent portions of the metal element 11 apart, as can be recognized in Figs. 2 and 3. This is, however, an extremely brief transition state, particularly since it

occurs inevitably due to the folding procedure. The invention in contrast provides that the marginal regions 13 are displaced in a direction facing transversely to the planar extent due to a targeted exertion of force and that the pulling apart of the marginal regions 13 only takes place after this targeted displacement step.

The displacement can be carried out using a shape correction unit 29 shown in Figs. 9 to 14. An apparatus in accordance with the invention for expanding a metal element 11 has, in addition to the shape correction unit 29, a stretching unit that is connected downstream of the shape correction unit 29, but that is not shown in Figs. 9 to 14. The stretching unit serves to hold the marginal regions 13 of the metal 11 and to pull them apart transversely to the longitudinal axis L and in parallel with the planar extent of the metal element 11. Specifically, the stretching unit can have clamping portions such as are disclosed in DE 10 2006 010 795 A1 engaging at the marginal regions 13.

An apparatus in accordance with the invention for expanding a metal element 11 can also comprise a pressing unit or rolling unit arranged downstream of the stretching unit for flat pressing or flat rolling the expanded metal element 11 and/or a feed unit for moving the metal element 11 along its longitudinal axis L in a feed direction R, which is likewise not shown in Fig. 9 to 14. An apparatus in accordance with the invention for expanding a metal element 11 can furthermore comprise an embossing unit, not shown, connected upstream of the shape correction unit 29 for generating the embossed pattern 27.

The shape correction unit 29 comprises two rotatable pressing rolls 30, 31 between which the metal element 11 is led. The pressing rolls 31, 31 are rotated in opposite directions during the leading through, either passively or by means of a drive.

The pressing rolls 30, 31 are preferably produced from steel and have respective pressing surfaces 33 that have two smooth outer portions 35, 36 and an embossed portion 39 arranged therebetween. The embossed portions 39 of the two pressing rolls 30, 31 are shaped in a complementary manner and are aligned matching each other so that the embossed pattern 27 is not impaired by the pressing rolls 30 31 on the leading through of the metal element 11.

The smooth outer portions 35, 36 of a pressing surface 33 furthermore extend at different spacings from the axis of rotation D (Fig. 10) so that they are radially displaced. A respective step 45 is therefore formed between the smooth outer portions 35, 36 and is arranged fully peripherally on the pressing surface 33. As can in particular be seen from Fig. 12, the step 45 in the embodiment shown is superposed by the embossed portion 39 and accordingly has a plurality of flanks 47. Instead of the embossed portion 39, however, a further smooth portion could also be provided, with the step 45 then preferably being formed as a single unilateral flank. It is understood that the steps 45 of the two pressing rolls 30, 31 are formed in a complementary manner so that on the leading of the metal element 11 through the pressing rolls 30, 31, the oppositely disposed marginal regions 13 are moved apart as desired transversely to the planar extent. The displacement defined by the steps 45 in the shape correction unit 29 amounts to 5 times the thickness of the metal element 11, which has proved favorable in practice. In the shape correction unit 29 described by way of example, the pressing rolls 30, 31 are spaced apart from one another such that the metal element 11 per se is not pressed or is not pressed by an appreciable amount (Fig. 13).

The deformation of the metal element 11 by the pressing surface 33 of a pressing roll 31 can be recognized in Fig. 14.

It is generally possible to carry out the generation of the embossed pattern 27, on the one hand, and the displacement of the marginal regions 13, on the other hand, not as described in different work stations as described above, but rather in a single work station. Such a work station can have a combined embossing/displacement roll or roller that due to its shape effects the displacement of the two marginal regions 13 and the forming of the stiffening embossed pattern 27 in one and the same workstep.

The invention makes possible a folding of the connection portions 19 with a reduced force effort and with exactly defined fold edges, whereby the expansion of metal elements 11 is significantly simplified.

Reference numeral list

11	metal element
13	marginal region
15	cut
17	central region
19	connection portion
21	kink line
25, 26	plane
27	embossed pattern
29	shape correction unit
30, 31	pressing roll
33	pressing surface
35, 36	outer portion
39	embossed portion
45	step
L	longitudinal axis
D	axis of rotation
R	feed direction

Claims

1. A method of expanding an elongated and at least regionally planar metal element (11) that has two respective marginal regions (13) that are oppositely disposed and that extend in the longitudinal direction (L) and a central region (17) that is arranged therebetween and that is provided with cuts (15), wherein the marginal regions (13) of the metal element (11) are moved apart transversely to the longitudinal direction (L) and in parallel with the planar extent of the metal element (11) such that connection portions (19) of the central region (17) formed by the cuts (15) and connecting the marginal regions (13) to one another are folded, characterized in that the marginal regions (13) are displaced with respect to one another transversely to the planar extent of the metal element (11) in a first method step before the moving apart and are moved apart in the displaced state in a subsequent second method step.
2. A method in accordance with claim 1, characterized in that a pressing tool or rolling tool (30, 31) whose pressing surface (33) has a step (45) defining the displacement is pressed onto the metal element (11) to displace the marginal regions (13).
3. A method in accordance with claim 2, characterized in that the step (45) is located in the region of the central portion (17) during the pressing of the pressing tool or rolling tool (30, 31) onto the metal element (11).

4. A method in accordance with claim 2 or claim 3, characterized in that the metal element (11) is led between two rotatable rollers (30, 31) whose jacket surfaces (33) have respective steps (45) having oppositely aligned flanks.
5. A method in accordance with claim 4, characterized in that the rollers (30, 31) are rotated in opposite directions on the leading through of the metal element (11) and are in particular driven in opposite directions.
6. A method in accordance with at least one of the preceding claims, characterized in that the marginal regions (13) are displaced with respect to one another by a shape corrected displacement that corresponds to at least three times, and at most 7 times, the thickness of the metal element (11).
7. A method in accordance with at least one of the preceding claims, characterized in that an embossed pattern (27) is embossed in the central portion (17) before or during the displacement of the marginal regions (13).
8. A method in accordance with at least one of the preceding claims, characterized in that the metal element (11) is moved in the longitudinal direction (L) during the displacement of the marginal regions (13) and/or during the moving apart of the marginal regions (13).
9. An apparatus for expanding an elongated and at least regionally planar metal element (11) that has two respective marginal regions (13) that are

oppositely disposed and that extend in the longitudinal direction (L) and a central region (17) that is arranged therebetween and that is provided with cuts (15), in particular an apparatus for carrying out a method in accordance with any one of the preceding claims, having a stretching unit that is configured to hold the marginal regions (13) of the metal element (11) and to move them apart transversely to the longitudinal direction (L) and in parallel with the planar extent of the metal element (11) such that connection portions (19) of the central region (17) formed by the cuts (15) and connecting the marginal regions (13) to one another are folded, characterized in that the apparatus comprises a shape correction unit (29) that is connected upstream of the stretching unit and that is configured to displace the marginal regions (13) with respect to one another transversely to the planar extent of the metal element (11).

10. An apparatus in accordance with claim 9, characterized in that the shape correction unit (29) comprises a pressing tool or rolling tool (30, 31) whose pressing surface (33) has a step (45) defining the displacement.
11. An apparatus in accordance with claim 10, characterized in that the pressing surface (33) has two substantially smooth outer portions (35, 36) at both sides of the step (45) and are associated with the marginal regions (13) of the metal element (11).
12. An apparatus in accordance with claim 10 or claim 11, characterized in that the pressing tool or rolling tool has at least one rotatable roller (30, 31) on whose jacket surface (33) the step (45) is peripherally formed.

13. An apparatus in accordance with claim 12,
characterized in that
the pressing tool or rolling tool comprises two rotatable rollers (30, 31)
between which the metal element (11) can be led, with the jacket surfaces
(33) of the rollers (30, 31) having respective peripheral steps (45) having
oppositely aligned flanks.
14. An apparatus in accordance with at least one of the claims 10 to 13,
characterized in that
an embossed pattern (27) that preferably extends beyond the step (45) is
formed on the pressing surface (33).
15. An apparatus in accordance with at least one of the claims 9 to 14,
characterized in that
the apparatus comprises a feed unit through which the metal element (11)
is movable in the longitudinal direction (L) during the displacement of the
marginal regions (13) and/or during the moving apart of the marginal
regions (13).
16. An apparatus in accordance with at least one of the claims 9 to 15,
characterized in that
the metal element (11) comprises galvanized steel, aluminum, or copper.
17. An apparatus in accordance with at least one of the claims 9 to 16,
characterized in that
the metal element (11) has a thickness of more than 0.5 mm, preferably of
more than 0.6 mm.
18. An apparatus in accordance with at least one of the claims 9 to 17,

characterized in that
the stretching unit has at least two clamping portions for a holding clamping of the marginal regions (13) and an apparatus for the automatic moving apart of the clamping portions.

19. An apparatus in accordance with at least one of the claims 9 to 18, characterized in that
the apparatus comprises a pressing unit or rolling unit connected downstream of the stretching unit for flat pressing or flat rolling the expanded metal element (11).
20. An apparatus in accordance with at least one of the claims 9 to 19, characterized in that
the apparatus comprises an embossing unit connected upstream of the shape correction unit (29) for embossing an embossed pattern (27) in the central portion (17).
21. An apparatus in accordance with at least one of the claims 9 to 19, characterized in that
the shape correction unit (29) has a combined embossing/displacement roller or roll by means of which both the marginal regions (13) can be displaced transversely to the planar extent of the metal element (11) and an embossed pattern (27) can be embossed in the central portion (17).